

THE ANNUAL ORATION ON SEX IN EDUCATION.

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[Abbreviated.]

WHEN that eccentric father of a family of geniuses, the late Rev. Mr. Brontë, desiring that his children should speak freely and without timidity, put them behind a mask and questioned them on various subjects, he was told by his son Branwell, then seven years old, in answer to one of his interrogations, that the best way of knowing the difference between the intellects of men and women is by considering the difference between them as to their bodies. That deliverance of the precocious boy seemed to his father at the time a wise saying, worthy of being recorded, and I daresay it seems the same to us as medical men to-day; but it is incontestable that there are now large numbers of cultivated persons to whom it must sound as foolishness, and a mere infantile echo of a barbarous prejudice.

There is a growing tendency around us to ignore intellectual distinctions between the sexes, to assimilate the education of girls to that of boys, to throw men and women into industrial competition in every walk of life, and to make them compeers in social intercourse. And as, to my thinking, this tendency is unphysiological, and likely if indulged to lead to some unfortunate results, I seize this opportunity to insist that there are differences between the intellects of men and women, and that these are best understood by a study of the differences in their bodies, and to suggest that forgetfulness of these differences is already doing injury in one department of education—I mean the high school education of girls.

The bodily differences between men and women which underlie their intellectual disparities are universal and intimate, and involve every organ and tissue. I shall not attempt an extensive anatomical survey. My present purpose will be served by directing attention to certain sexual differences in one bodily organ, the brain. But before I do so I wish to say one word as to the origin of these sexual differences. The radical explanation of sex is to be sought in what Michael Foster has called "the protoplasmic movement," that is to say, in the integrative and disintegrative changes of living matter. Anabolic and katabolic processes are manifold, vary in their relative ascendancy in different individuals, and are influenced by environment, so that, in tracing their operation through the animal kingdom, qualifications and explanations are from time to time needful, but, subject to these it is everywhere obvious that the female is the outcome and expression of predominant anabolism, and the male of predominant katabolism. A study of the organic and functional, primary and secondary sexual characteristics, of the normal development of the tissues and of their pathological modifications makes this evident, and a study of the emotional and intellectual characteristics of men and women leads to the same conclusion. Man is more wilful, enterprising, passionate, and energetic, that is to say, more katabolic in the mental sphere, while woman is more receptive, tranquil, affectionate, and constant, that is to say, more anabolic in the mental sphere. His restless habits give man a wide range of experience, and so amplify his intelligence, but her narrower existence concentrates her powers and so quickens her perceptions. Sudden in impulse, brave and independent, fickle and eager after novelty, man is more original while woman, patient, trustful, compassionate, and timid, excels in rapid intuition.

Differences in intellect imply cerebral differences, and it is of importance to ascertain what these are; and first amongst cerebral differences between the sexes, I would refer to mass and weight. It is a matter of common observation that women have smaller heads than men, and it is a matter of scientific observation that in all peoples and races without exception, the absolute weight of the entire brain is, on the

average, greater in men than in women. There is, however, a correlation between brain weight and stature, and, laying hold of this fact, the advocates of woman's rights and might have argued that the deficiency in her brain weight, when compared with that of man, is no more than is to be accounted for by her fewer inches; but this position is quite untenable. I do not know a trustworthy standard of the brain weights of healthy natives of this country to which to appeal, but I can submit to you a table showing the results of the weighing of the brains of a large number of insane persons all English, Scotch, or Irish, but mostly English, which, in this relation, is absolutely reliable.

Brain Weight.

Sexes.	Average Weight of Brain.		Average Height.			Excess of Male over Female Brain Weight.		Excess of Male Brain Weight after Allowance for Height.	
	Grams.	Ozs.	Metres.	Feet.	Inches.	Grams.	Ozs.	Grams.	Ozs.
945 Males ...	1350.54	47.64	1.702	5	7	127.68	4.50	29.71	1.05.
655 Females	1222.86	43.14	1.575	5	2	—	—	—	—

In this table are summed up the brain weights of 1,600 persons: 945 males and 655 females, ranging from 10 to 80 years of age, the weighing of the brain having been in each case conducted by myself or under my own supervision. The brains of males exceeded those of females in weight by 127.68 grammes, or 4.50 ounces on the average, and, after allowing for differences of stature, taking 5 feet 7 inches as the average male height and 5 feet 2 inches as the average female height, there is still an excess of brain weight of 29.71 grammes, or 1.05 ounce in favour of the male.

The table deals with lunatics dying in asylums, and, amongst them, organic diseases of the brain involving loss of substance are much more frequent in men than in women. Women are oftener attacked by insanity, but men oftener die of it. General paralysis of the insane, atrophy and softening of the brain, senile dementia, and other diseases, causing wasting of the convolutions, are far more fatal to men than to women, who, when they die in asylums, succumb most frequently to bodily diseases which do not seriously interfere with the nutrition of the brain. And so it comes, about that of the brains weighed in the *post-mortem* theatre of an asylum, those of men are, on the average, much more water-logged and reduced below their normal bulk than those of women.

The effect of organic diseases and the atrophic changes they induce in lowering, in my tables, the normal difference between the male and female brain may be statistically demonstrated from these tables themselves. It is from 30 to 50 years of age that the mortality from general paralysis, which destroys 4 men to 1 woman, and from other fatal forms of organic brain disease, preferentially attacking men—except, of course, senile dementia—almost exclusively occurs, and it is in this section of life that the sex difference in brain weight in my tables falls to the lowest point at the very time when, under normal circumstances, it ought to be greatest. The average excess of weight in the male, as compared with the female brain, from 30 to 50 years of age in my tables was 123.5 grammes or 4.37 ounces, while from 20 to 30 years, when deaths from organic brain disease are rare, it was 169.9 grammes or 6.01 ounces. All available evidence points to the conclusion that the male brain exceeds the female brain in weight in this country to an even greater degree than has been hitherto believed. And that the smaller size of the female brain is a fundamental sexual distinction, and is not to be accounted for by the hypothesis that environment, educational advantages, and habits of life, acting through a long series of generations, have stimulated the growth of the cerebrum in one sex more than in other, is made clear by the fact that the same difference in brain weight between men and women has been found in savage races. And not only is the male brain heavier than that of the female, but it has a wider range of variation in weight. The very big brains and the

very small brains are encountered just as are geniuses and idiots, giants and dwarfs more frequently amongst men than amongst women.

There are grounds for believing that there is a difference in the balance of parts in the male and female brains respectively, and this difference I adduce as the second sexual distinction between them. Broca—no mean authority—has declared that the occipital lobes are more voluminous in the female than in the male, and my own observations published in *Brain* in 1880 confirm, as far as they go, his conclusion, and show that while the frontal lobes are equally developed in both sexes, the parietal lobes corresponding roughly with the motor area of Ferrier are larger in the male than in the female, and the occipital lobes, certainly sensory in their functions, are larger in the female than the male.

The third brain difference between the sexes to which I would allude is one of convolitional arrangement, which the examination of a series of photographs of brains of men and women stripped of their membranes pretty clearly reveals. The brains of women, like their bodies generally, are upon the whole more symmetrical than those of men. The difference which I have found in the weight of the hemispheres points to this conclusion, for in males the right hemisphere exceeds the left in weight by 3.7 grammes, and in females by only 2.1; but pathological considerations as to the regional distribution of wasting in organic diseases forbid me to attach too much importance to this observation, and I prefer to trust to mere ocular inspection, which will, I think, bring home to anyone who diligently uses it the superior symmetry of the female brain due to its comparative poverty in secondary gyri.

It is in the internal structure of the brain, in the depth and arrangement of its grey matter, in the size, form, and connections of the cortical cells in different areas, that the most essential structural differences between the male and female brain in all probability reside, but the internal structure of the brain in this relation is as yet uninvestigated. I may mention, however, one fact. During a very laborious inquiry into the specific gravity of the grey matter of every gyrus of the brain, which I carried out some years ago, I succeeded in obtaining three standard brains of perfectly healthy adults—two men and one woman—killed in accidents, and in these I found that while the specific gravity of the medullary substance of the brain was alike in all in each region, namely 1044, that of the grey matter varied remarkably. To take the frontal convolutions as an example, in one male the grey matter of these had a specific gravity of 1037, in the other of 1036, but in the female its specific gravity was only 1034. And not only in the frontal region but in every convolution the specific gravity of the grey matter was lower in the female than in the male.

In several cases of death during acute insanity which I examined in which there had not been time for the establishment of degenerative changes, the specific gravity of the grey matter in every lobe of the brain was generally lower in the female than in the male, while the specific gravity of the white matter always closely corresponded in the two. In all degenerative diseases of the brain, and especially in senile decay, there is a reduction in the specific gravity of the grey matter, which sometimes falls as low as 1028 in the frontal region; and the fact, if it be a fact, that the grey matter in the female brain is of less density than that in the male brain must mean that it is a less highly nourished and developed tissue.

And there is still another brain difference between men and women which I must submit to you, and that a very momentous one, namely, vascular supply. During the last four years Dr. Sidney Martin and I have, as opportunity has offered, carried on an inquiry as to the size of the great arteries that supply the brain. As the result of our observations, which have been conducted by Dr. Sidney Martin with scrupulous care, and by new methods, insuring, I believe, great accuracy of measurement, we have found that the diameter of the internal carotid and vertebral arteries, taken together, is slightly greater in the male than in the female. Their combined diameter is 8.2 millimetres in the male and 8.0 millimetres in the female, but when the difference in size of the male and female brain is taken into account, it is found that in proportion to brain

weight their diameter is greater in the female than in the male, and so it appears that, upon the whole, the female brain receives a larger supply of blood in proportion to its mass than does the male brain. It is to be remembered that the blood going to the female brain is somewhat poorer in quality than that going to the male brain and contains only 4,500,000 corpuscles to the cubic millimetre, instead of 5,000,000 in the case of the male. (See table on next page.)

In 10 male brains of adults free from brain disease, and ranging from 25 to 36 years of age, the internal carotid arteries had an average diameter of 2.8 millimetres on the right side and 2.75 millimetres on the left side, while the vertebral arteries had an average diameter of 2.2 millimetres on the right side and 1.875 millimetre on the left side; whereas in 10 female brains of adults free from brain disease, and ranging from 25 to 43 years of age, the internal carotid arteries had an average diameter of 2.6 millimetres on both sides, while the vertebral arteries had an average of 2.3 millimetres on the right side and of 2.075 millimetres on the left side.

It thus appears that the distribution of the blood in the male and female brain respectively varies to a considerable extent. The internal carotid arteries, with their great branches, the anterior and middle cerebral arteries, supplying the supraorbital convolutions and island of Reil, the gyrus fornicatus, the Rolandic area, the angular gyrus, and the first temporo-sphenoidal lobule are much larger both absolutely and relatively in the male than in the female brain, but the vertebral arteries which supply the occipital and temporo-sphenoidal lobules are larger in the female than in the male brain, and the basilar artery, which is practically a continuation of the vertebrals, is also larger in the female brain, where its average diameter is 2.8 millimetres, than in the male brain, where its average diameter is 2.675 millimetres. It might be thought that the free anastomosis provided by the circle of Willis renders comparatively unimportant differences of calibre in the internal carotid and vertebral arteries, and must equalise the blood currents to the different regions of the cerebrum; but the fact is that the posterior communicating arteries—which when dilated after the occurrence of any pathological obstruction on the cardiac side of the circle of Willis, maintain the circulation in the brain in tolerable integrity—are incapable, while normal, by their calibre and position of adjusting the balance between the direct currents of the carotid and vertebral arteries, and it is certain that the result of the difference in the diameter of these in the two sexes which I have recorded is this, that the anterior region of the brain is comparatively more copiously irrigated with blood in men and the posterior region in women. The region of the brain which in men is most richly flushed with blood is that which is concerned, we have reason to believe, in volition, cognitions, and ideomotor processes; while the region which in women is most vascular is that which is mainly concerned in sensory functions, and we thus see that there is a relation between the size of the cerebral arteries, and what observation has taught us as to the intellectual and emotional differences of the sexes.

Differences in brain structure and function, which at every stage of existence separate the sexes, have a special pathological significance at the period when sexual divergence is taking place most rapidly and when education is being pushed forward with most vigour. Education from first to last can only be safely conducted in the light of cerebral physiology, but unfortunately those charged with the conduct of education too often dispense with that light or regard it as misleading.

I have no wholesale indictment to bring against high schools for girls. They have done good service to sound education, have widely diffused its benefits, have supplanted second-rate boarding schools, and have opened up to girls interests and helpful attainments which were formerly denied them. Even from an educational point of view, however, the work done by high schools for girls is not all pure gain. They deprive their pupils to a considerable extent of home lore and practice and tend to induce in them sameness and narrowness of intellect. These schools cannot vary or adapt their teaching to individual tastes and talents, but have one keynote for all, and so sacrifice to clearness of utterance many delicate inflections and cadences of faculty.

It is not, however, about the educational advantages or

*Showing Weight of Brain and of its Hemispheres, Diameters of the Great Cerebral Arteries, etc., in 10 Adult Males
and 10 Adult Females free from Brain Disease.*

Ages.	Average Weight of Brain (Grammes).			Average Diameters of Arteries in Millimetres.								Excess of Male over Female Carotid Arteries (Milli- metres).	Excess of Female over Male Vertebral Arteries (Milli- metres).
				Carotid Arteries.			Vertebral Arteries.			Basilar.	Carotid and Basilar together.		
	Right Hemi- sphere.	Left Hemi- sphere.	Total Brain.	Right Hemi- sphere.	Left Hemi- sphere.	Both Hemi- spheres.	Right Hemi- sphere.	Left Hemi- sphere.	Both Hemi- spheres.				
Males: 25 to 36 years	582.1	580.1	1336.1	2.8	2.7	5.5	2.2	1.9	4.1	2.7	8.2	0.3	—
Females: 25 to 43 years	540.7	539.3	1229.3	2.6	2.6	5.2	2.3	2.1	4.4	2.8	8.0	—	0.3

drawbacks of high schools for girls that I wish to speak, but about the dangers to health which lurk in their aims and methods. I do not hesitate to affirm that overpressure is rampant in high schools for girls in this country to-day. Much depends on the head mistress. If she is judicious and sympathetic overpressure is reduced to a minimum; if she is hard and keen it is raised to a maximum. I willingly admit that in high schools for girls generally there is a sincere desire to avoid overpressure, and I have no doubt that, during the last five or six years, there has been considerable mitigation of it; but I am confident that, notwithstanding all precautions and mitigations, overpressure still prevails in these schools extensively, and sometimes acutely, and that it will prevail as long as they imitate schools for boys, and fail to recognise sexual distinctions.

There are those who believe that overpressure is merely a medical myth; while many high school mistresses will doubtless deny that girls are overworked in the establishment under their care, they will one and all admit that overwork is a contingency against which they have to be constantly on their guard. For obvious reasons, it is difficult to get direct and trustworthy evidence about overpressure in high schools, but thanks to the kindness and magnanimity of the head mistress of one English high school—one in which special precautions against over-pressure were taken—I obtained, a

few years ago, a return which I regard as of great interest, and which throws some light on the matter.

The facts on which this return is founded were got at by questions, put and answered in writing, the answers sent in by each girl being afterwards tested by private cross-examination by her form mistress, and in some cases by communications with parents, so that the return is, I believe, absolutely reliable. And it is certainly not a little remarkable to find from it that, out of 187 girls belonging to the upper and middle classes, well fed and clad and cared for, and ranging from 10 to 17 years of age, as many as 137 complained of headaches, which in 65 instances occurred occasionally, in 48 frequently, and in 24 habitually. That the headaches were connected with school work is made probable by the fact that while in 26 cases they are stated to have occurred in the morning, in as many as 76 they are set down as of most frequent occurrence in the afternoon and evening, when, according to an immense majority of the girls, the hardest part of the day's work falls on an already jaded brain. And there are other significant facts in this return besides those relating to headaches, for as many as 37 of the 187 girls were short-sighted, and 4 of them exhibited choreic movements. This return represents no exceptional state of things. Inquiries made quite lately satisfy me that a very large proportion of high school girls still suffer from headache, that neuralgia is

High School for Girls.

Form.	No. in Form.	Average Age.	Which Part of your Work do you find Hardest?	When do you do your Home Work?	Do you Suffer from Headaches?	How often do your Headaches Occur?	At what part of the Day do your Headaches Occur?	Short Sighted.	Muscular Twitchings.
VI and V.	17	17	Home work ... 15 Class work ... — Equal ... 2	Afternoon ... 4 Evening... ... 2 After. and even. 11	No 5 Yes 12	Occasionally ... 7 Frequently ... 3 Habitually ... 2	Morning ... 2 After. and even. 2 No special time 7	3	None.
IV.	25	16	Home work ... 22 Class work ... 1 Equal ... 2	Afternoon ... 5 Evening... ... 4 After. and even. 16	No 3 Yes 22	Occasionally ... 9 Frequently ... 9 Habitually ... 4	Morning ... 5 After. and even. 14 No special time 3	7	None.
Upper III.	19	15	Home work ... 16 Class work ... 1 Equal ... 2	Afternoon ... 4 Evening... ... 3 After. and even. 12	No 4 Yes 15	Occasionally ... 9 Frequently ... 5 Habitually ... 1	Morning ... 5 After. and even. 10 No special time 0	6	None.
Middle III.	26	15	Home work ... 7 Class work ... 3 Equal ... 16	Morning ... 3 Afternoon ... 6 Evening... ... 6 After. and even. 11	No 3 Yes 22	Occasionally ... 11 Frequently ... 7 Habitually ... 4	Morning ... 7 After. and even. 12 No special time 3	4	One.
Lower III.	24	14	Home work ... 15 Class work ... — Equal ... 9	Afternoon ... 7 Evening... ... 3 After. and even. 14	No 8 Yes 16	Occasionally ... 11 Frequently ... 3 Habitually ... 2	Morning ... 3 After. and even. 11 No special time 3	3	Onc.
Upper II.	29	13	Home work ... 20 Class work ... — Equal ... 9	Afternoon ... 15 Evening... ... 4 After. and even. 10	No 3 Yes 26	Occasionally ... 12 Frequently ... 5 Habitually ... 9	Morning ... 1 After. and even. 11 No special time 3	5	None.
II.	32	12	Home work ... 19 Class work ... 10 Equal ... —	Afternoon ... 19 Evening... ... 3 After. and even. —	No 12 Yes 17	Occasionally ... 6 Frequently ... 10 Habitually ... 1	Morning ... 4 After. and even. 10 No special time 3	5	None.
I.	15	10	Preparation in this form is done in the morning. No home work.	Morning ... 15	No 8 Yes 7	Occasionally ... 6 Frequently ... — Habitually ... 1	Morning ... 0 After. and even. 6 No special time —	4	Two.

common amongst them, that they display multifarious indications of nervous exhaustion, and that many break down in the middle of term.

But if we had no evidence of suffering or disability immediately resulting from high school training as it is now carried on, we as medical men should not hesitate to pronounce that training in some respects pernicious from a consideration of its character alone. Two-thirds of high school girls attest that the hardest part of their work, preparation—which involves the opening up of new ground, an advance on what has been already learnt, and unaided effort in surmounting obstacles—has to be performed in the evening when they are already worn out, at the very time when in the cycle of daily life their brains are least capable of exertion. And no inconsiderable number of high school girls will attest that this arduous work of preparation is often carried on until 10, sometimes even until 11 o'clock at night.

The time tables or cards issued to pupils and parents, defining with the utmost nicety the number of minutes that are to be devoted to preparation in each particular subject on each particular day, fixing a maximum duration of home work—generally from two to three hours—which is not to be exceeded without an intimation of the fact to the head mistress, are practically useless. Not one girl in ten steers by these charts, not one parent in ten reports the transgression of their terms.

The drudgery of education should be done in school with skilled assistance when the brain is in its prime vigour, not at home, unaided, or with only precarious parental help, when the brain is already fatigued. I feel strongly that no girl from 10 to 17 years of age should have any forced brain work to do after 7 P.M., and that a reduction is required in the number of hours that high school girls are now called on to give to brain work.

I have given prominence to the question of home work in connection with high school education because I regard it as one of the chief evils of the system. A criticism of the curriculum and of the subjects taught cannot be undertaken here, but a word must be said about the competition which is still encouraged in some quarters. It is intellectually and morally injurious to them and disturbs the equilibrium of health. Emulation should be banished from their education, and marks, places, and prizes tabooed, and examinations too, which harass and agitate, should be as much as possible avoided.

In some high schools the authorities are on the alert on the subject of overpressure. But it is a melancholy fact that some of the expedients resorted to with this purpose tend to aggravate rather than to abate it. One head mistress told me proudly that her practice was whenever the girls in any form began to get very sluggish and drowsy at their work to close the books and give them ten minutes' drill. She thought I was joking when I said that she had much better put them to bed and give them caudle, but I was quite serious, for muscular fatigue is not the remedy for cerebral exhaustion, although it is very commonly believed to be so. Drill is highly to be commended in its proper place, so are gymnastics, so are games, but they will not create a tolerance of mental overpressure nor counterbalance its evils. It is quietism, not athleticism, that has to be preached in high schools in the first place.

The evils resulting from overpressure in high schools for girls, whether that overpressure be due to home work or competition or examination strain, are brought about through its influence on the cells of the brain. When the cells of the brain are stimulated in excess of their powers of taking up nutriment, as they are during forced mental labour, or when suitable supplies of nutriment are cut off from them, as may be the case during the impairment of digestion which forced mental labour not rarely entails, then the metabolism in these cells is, we may infer, altered, and they degenerate and secondarily induce widespread degenerative changes throughout the system. The group of symptoms which is characteristic of the mental failure which follows upon severe overpressure, and which may be summed up as acute or apathetic dementia, is almost identical with that seen in cases in which mental failure has followed upon acute specific diseases; and in mental failure of the former kind, not less than in the

latter, we have also sometimes dilatation of the heart and changes in the liver, kidneys, and voluntary muscles. And in both kinds of mental failure, recovery takes place, if the fatty degeneration has not so far advanced that the active protoplasm of the cells is absorbed, whenever the cells which have had extra work thrown on them are allowed absolute rest, and are placed in favourable conditions as regards nutrition.

The slight mental changes which are similarly induced are most generally akin to apathetic dementia. Thus it is no uncommon event to hear overworked high school girls complain that their power of acquisition and attention is impaired; that they take far longer to do their work than they used to do; that they cannot remember what they have learnt; that they read their lessons without understanding them; that they sometimes lose themselves and forget where they are; and that what they call queer thoughts keep coming into their minds, while the observation of these girls at the same time reveals that they are languid and irresolute or unusually irritable. Such slight departures from normal mental states, for the most part, go no further, but are rectified by the holidays, but now and again they advance into that mild coma which corresponds with apathetic dementia.

Besides apathetic dementia there are many other mental aberrations to which overpressure may lead up, the nature of these in each case being determined by the inherited tendencies, antecedents, or environment of the girl. We may have cyclones of mania or anticyclones of melancholia, hurricanes of morbid impulses, or the settled bad weather of moral perversion. And as regards certain minor mental changes which thus arise, it is noteworthy that they are often concealed by girls who do not comprehend and can scarcely explain them. This is particularly the case with reference to those voluminous mental states described by Dr. Hughlings Jackson, which are sometimes the harbingers of epilepsy.

I cannot pretend to classify or describe the vagaries of nervous disturbance that present themselves to medical observation in girls in these days, and in the production of which overpressure plays some part, but I would name insomnia, of the commonest occurrence, often of evil import, sopor or sleep so deep and difficult to break as to be almost cataleptic in nature, neuralgia, chorea, and hysteria. And besides nervous disturbances, there are many ailments and diseases begotten or fostered by overpressure. Chief of these is anæmia and general delicacy. Women suffer from anæmia in far larger proportion than men. In the ten years 1881 to 1890 the deaths from anæmia, chlorosis, and leucocythæmia in England and Wales were 33.29 per million living amongst men and 54.83 amongst women. As is well known chlorosis and anæmia show themselves in girls from 10 to 20 years of age more frequently than at any other period of life, and may be induced by mental worry or excitement, which cause a diminished production of blood corpuscles. In his very able investigation into the physical and mental condition of school children Dr. Francis Warner has satisfied himself that mental stimulus applied to children "does lower their general nutrition."

Large numbers of high school girls suffer from loss of appetite, a certain number go to school without breakfast. Worn out, they oversleep themselves, and leave scant time for the morning meal, or, after a night of broken rest, they rise unrefreshed, swallow a cup of tea, the neurotic properties of which they have already discovered, but decline solid food, or merely trifle with it. They labour under a gastric disorder now so common that it might receive a distinctive appellation, and be called *anorexia scholastica*, in which the lessened flow of energy from the exhausted nervous centres retards the functions of all the abdominal viscera. Buns in the forenoon—a regular institution at all high schools now—are very well in their way, but they do not compensate for a lost breakfast; and I hold that no girl who has shirked that meal should be allowed to go to school or engage in brain work.

The ailments of girlhood ascribed to overpressure do not always end with the cause that induced them. The headachy girl is not unlikely to grow into the migrainous and invalid woman. A voluminous mental state may develop into epilepsy. Somnambulism leads up to hysteria, insomnia lays the foundation of insanity, and anæmia at the growth period may entail life-long debility. The increase in stature and weight

of the girl, according to Dr. Bowditch's recent observations, goes on much more rapidly than that of the boy from the tenth to the fourteenth year; and while her pelvis is expanding, her special organs and mammae and sebaceous glands are developing and becoming more vascular, and her physical energies are gathering strength under the governance of new impulses, there exists in her a special proclivity to disease and to the assumption of morbid tendencies.

The proof of this can be readily supplied. Let us examine the incidence of zymotic affections upon the sexes. Throughout life, in every quinquennium, the mortality of males from small-pox exceeds that of females, and that in a very marked degree, except in one quinquennium—from the 10th to the 14th year—when the female exceeds the male mortality, being again but very slightly behind it in the succeeding quinquennium—from the 15th to the 19th year. At all ages the male death-rate from enteric fever exceeds that of females, but the female mortality is very considerably higher from the 3rd to the 20th year of life. In infancy and also in old age the male mortality from diarrhoea and dysentery exceeds the female mortality, but in the child-bearing period from 15 to 45 years of age the mortality is distinctly higher amongst females.

And even more striking in this connection are the statistics of phthisis. Phthisis is more fatal to males than

Phthisis: Mean Annual Death-rates per Million living at Successive Age Periods, and per "Standard Million" at all Ages, during the Ten Years 1881-1890.

Ages.	Males.	Females.
All ages	1876 (standard million)	1602 (standard million)
0	527	493
5	250	322
10	349	712
15	1317	1839
20	2350	2355
25	3083	2850
35	3614	2748
45	3574	2085
55	2863	1496
65 and upwards	1534	830

females under 5 years of age, but then a change takes place, and from 5 to 10 it is much more fatal to females than to males, while from 10 to 15 it is more than twice as fatal to females as to males. From 13 to 20 phthisis is still much more fatal to females than to males, from 20 to 25 the mortality from it is exactly equal in the two sexes, and from 25 to 30 and at all subsequent ages the mortality from it is much greater amongst males than amongst females.

Now this distribution of phthisis mortality, especially when viewed in connection with the fact that the reduction in it which is happily going on at all ages has been proportionately less of late years amongst females than amongst males from 5 to 14 is highly significant. It is not, of course, suggested that high school operations have had anything to do with this diminished reduction. The total number of girls attending them is so small in comparison with the population, that no amount of mischief they could do would appreciably affect the Registrar-General's returns. But the fact that there is a special proclivity to phthisis in girls from 5 to 20 years of age, and that girls between these ages are not sharing as fully as boys in the benefits of the preventive measures which we owe to modern sanitation, viewed in connection with the conditions of high school work, suggests that one of the remote evils of overpressure in them will be the propagation of phthisis in those who have been subjected to that overpressure.

If it were our object to secure an abundant harvest of phthisis, I do not know how we could better set about it than by providing for general overpressure in high schools for girls. Keep a large number of town-bred girls in a constant state of nervous tension, so as to abbreviate sleep and impair appetite, deprive them as much as possible of fresh air, insist on their writing and poring over books for prolonged periods, and scatter amongst them a few cases of tuberculous disease, and you will inevitably in the fulness of time have a rich growth of phthisis.

But the special proclivity to disease of girls at the growth period, and the influence of the nervous erethism by which they are then visited may be traced out not only in zymotic diseases and in phthisis, but in nervous diseases themselves. Suicides which spring from causes identical with those which are productive of insanity, and which are an expression of mental disorder, are four times more numerous amongst men than women, and the male death-rate from suicide is much greater than the female at all ages except, strange to say, from 15 to 20, when the female death-rate rises considerably above the male. The rate of increase of suicides during the last twenty years has been much higher amongst women than amongst men.

Chorea, which is at all ages more fatal to females than to males, reaches a rate of mortality amongst females from 10 to 20 years of age that is phenomenal when contrasted with the rates at other ages and in connection with the mortality from this disease; it is of extreme interest to note that while the male mortality due to it has declined during the last thirty years, the female mortality has risen, and has risen rapidly, during the last ten years. Chorea is seldom fatal, and the increase of the death-rate from it amongst girls must betoken a large increase of the malady in its milder forms.

I might go on enumerating nervous and other diseases, the mortality from which mounts up from 10 to 17 years of age in girls; but enough has been said to show that there is a dangerous instability of the nervous system at this epoch. And, indeed, the most convincing proof of this instability is to be found, not in the mortality returns, but in the extraordinary prevalence during this section of female life of functional nervous disorders, which do not kill but cripple and perplex, and are often the source of misery long drawn out.

Men are much more liable than women to gross structural lesions of the nervous system, including the various forms of inflammation of the brain and spinal cord and their membranes—paralysis, locomotor ataxy, muscular atrophy, and abscesses and tumours of the cerebrum—and there can be little doubt that their greater liability to these lesions is dependent upon, first, the innate higher metabolic activity of their nerve centres, and secondly, their greater exposure during the struggle for life, to the causes of nervous disease. Women owe their comparative immunity from organic nervous diseases to their anabolic habit and to the tranquil and sheltered lives which they have led. But if all this is to be altered, if women are to be made as katabolic as possible and are to take part in the struggle for life on equal terms with men, then it follows that they will have to a great extent to sacrifice the comparative immunity from organic nervous diseases which they have hitherto enjoyed.

Five men suffer from the motor form of writer's cramp for every one woman who so suffers, and the explanation of this lies on the surface, in the fact that men are employed in writing far more numerous than women. Four men die of general paralysis of the insane for every one woman who so dies; is it not feasible to suppose, then, that women owe their comparatively small liability to this fell malady to their comparative freedom from the stress and strivings of professional and business life which so often lead up to it in men? To make women katabolic—and that is, I maintain, what high school education tends to do; to throw them into competition with men, and that is, I maintain, what some high school education aims at—is to insure to them a largely increased liability to organic nervous disease. And so overpressure from 10 to 17 years of age may have amongst its remote consequences, not only the reproduction in the same or modified forms of the functional nervous disorders which so often manifest themselves at that period, but a crop of gross nervous degenerations which have up to this time been rarely seen in women. And notwithstanding all Weismann's arguments, I would say: Woe betide the generation that springs from mothers amongst whom gross nervous degenerations abound!

The study of the effects of overpressure immediate and remote on the monthly rhythm and on the fitness and capacity of the woman to reproduce the species and to bear healthy children—health implying both bodily and mental vigour—must be kept for separate examination at some other time. So also must a study of the effects of overpressure as

applied in colleges and halls to young women at from 18 to 24 years of age. Admirable culture is supplied in these colleges and halls, but they, too, have their risks notwithstanding that their pupils are all picked lives. The suicide of a pupil who had just undergone examination at one of them was reported two months ago. I must, however, even now express my belief that the University of St. Andrews, in deciding, as it has lately done, to open all its classes in arts, science, and theology to women as well as men, has taken, not a retrograde step—for our ancestors never did anything so foolish—but a downhill step towards confusion and disaster. Its now empty benches may be thronged with pupils, its professors may batten for a time on duplex fees, but the attempt to educate young men and women, not only on the same lines, but in the same coaches, cannot but prove injurious to both. "What was decided amongst the prehistoric protozoa cannot," it has been well said, "be annulled by Act of Parliament," and the essential difference between male and female cannot be obliterated at a sweep of the pen by any *Senatus Academicus*.

THE MORTON LECTURE ON CANCER AND CANCEROUS DISEASES.

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THE ETIOLOGY OF CANCER.

MR. PRESIDENT AND GENTLEMEN,—I understand that the Morton lectureship was established with the view, in the first instance, that the lecturer for the time should gather together and give in the form of a summary any fresh light that has during the preceding year been shed on the subject of cancer. Beyond this, however, the object of the founder appears to be to stimulate thought and research in connection with a disease, the importance of an accurate knowledge of which is at present only equalled by the futility of all the efforts that have been made to elucidate even a few of the problems that a most cursory glance at the subject must at once suggest.

We owe to histology and to statistics almost all the knowledge concerning cancer that has hitherto been acquired, and most of the answers to such questions as have been solved. The clinician, to whom cancer has been a study of most absorbing interest, has done all that was within his power, but beyond determining the bounds of the periods of life during which it may occur, and the nature of the hereditary predisposition of certain subjects and tissues, this all has been but little. Even the attempts to associate the growth of cancer (and, by cancer, I shall to-day mean cancer in the strictest limitation of the term) with any specific causal agent has hitherto failed, and I must confess that, until quite recently, I have remained strongly of the opinion that, although cancer may possibly be the result of certain forms of irritation, it can scarcely be looked upon as due to the vital activity of any specific micro-organism, whether animal or vegetable; in fact, I am not yet prepared to depart entirely from this position, though I must acknowledge that comparatively recent observations have been made which, if ultimately confirmed, would go far to limit the range of irritants which possibly may give rise to the proliferation of the special tissues with their special arrangement so characteristic of cancerous growths.

It will be well that we should for a moment turn our attention to some of the work that has already been done in this domain. A former distinguished Morton lecturer, the late Mr. John Marshall, pointed out that up to his time most of the advances made in our knowledge of cancer were the outcome of a close study of its histological structure, and that no advance could possibly have been made as regards the classification of malignant tumours until we had obtained an accurate knowledge of their essential morphology. Virchow's doctrine that all tumour and other cells

have their homologues in the embryonic or adult tissues of the normal body renders it necessary that we should determine how far the form and arrangement of the tissue-elements correspond with any of these, and in what respect they agree with such structures during the process of development of the organism, and at what periods and under what conditions such homologues occur. Departing somewhat from this doctrine, Mr. Marshall described the tissues met with in cancer as not resembling those in process of development, but corresponding rather to tissues in a state of anarchy. Whether we accept one idea or the other—and I must say I incline to Virchow's original idea—the conditions met with in cancer can only be initiated when two different sets of factors are brought into play: (1) There must be altered conditions within the tissues, impaired nutrition, impaired vitality, deficient controlling power either from within or without; and (2), almost equally important, there must be some special or long-continued stimulus, the exciting cause of proliferation from without, which leads to the formation of tissues of an embryonic or an anarchic type; and whether we speak of growth or of anarchy, these two sets of embryonic factors will always have to be reckoned with.

What I have to say to-day may be arranged under three heads:—

1. The conditions within the tissues that may predispose to the formation of cancerous tumours.

2. What we know as to the nature of the irritants that are now assumed to play a specific etiological part in the production of cancers.

3. What is to be gathered in respect to the treatment of cancer from recent researches on the subject.

It has frequently been insisted upon that the nucleus plays a most important part in determining the multiplication of cells. We may say, indeed, that the nucleus is the active part of the cell, in the sense that it is always the first part of the cell to undergo division. From the extraordinary size and distinctness of the nucleus and nucleolus of the cancer cell, some have gone so far as to indicate that these are practically sperm and germ cells respectively. Within these there is undoubtedly during the normal life of the individual a power of multiplication, a power which, however, varies greatly at different stages of this life. When this power dies out, under normal conditions, a man is said to die of old age, and it is necessary for the continuance of the species that there should be a recurrence to a process of direct reproduction through the well-nourished ovum and the highly differentiated sperm cell, by the conjunction of which the cycle is recommenced. Here we have, just as really as in the case of certain parasitic organisms, a kind of cycle or alternation of generation. Although asexual reproduction can go on for a time, there comes a point at which it is necessary that sexual generation should step in. This takes place even under normal conditions, but it must be remembered that under certain conditions and at certain periods of life the nutrition and reproductive powers of different sets of cells may be profoundly modified in one direction or another. At one time, as has often been insisted, the connective tissue cells are most active, at another the epithelial cells. It must be further recognised that we may come into the world middle-aged men and women as far as our tissues are concerned. The ovum or the sperm cell, or both, have had their nutrition and activity so diminished before they came together, that the resulting individual has not had a fair start in life, whilst even those who have begun with everything in their favour as regards embryogenetic conditions, have so suffered from impaired nutrition and from disease that their tissues in turn are old before their time; we have premature senescence, and a marked liability to those diseases associated with old age. Only in this way can we account for many of the anomalous conditions that make their appearance in the practice of the surgeon, and are tabulated in the statistics of all those who have paid attention to the subject.

More than forty years ago, when Virchow brought forward his epoch-making doctrine that in all pathological, as in all physiological processes, cells beget their like, he at the same time shadowed forth the idea, that, although all cells are begotten of other cells, the progeny only resemble their parents: